CHAPTER I.

THE SALIVARY GLAND AS THE SEAT OF RABIES.

THE bite of a rabid animal being in every case essential to infection, it might naturally be expected, and in point of fact has been from time immemorial inferred, that the infective material of rabies lies in the salivary secretion and salivary glandular substance; or, in other words, that the salivary gland is the prime seat of the rabific microbe and the special centre of the elaboration of its "virus." Long before and up to M. Pasteur's investigation, this was a deeply rooted and widely spread idea. Now there can be no question that the "virus," or rabies-germ, or both agents, are to be obtained more constantly from the salivary secretion than from any other secreting structure in the infected organism. Why the salivary secretion should thus, above all secretions, be so frequently, and likewise invariably so *primarily* affected, is not without significance, and will receive careful attention in the sequel. Meanwhile, it is essential to point out that if the "virus" is present in the salivary gland and its secretion, when absent from all others, it by no means follows that it is invariably so. Not every mad dog, as so generally believed, is capable of imparting infection with its bite, although it be an effectual one, *i.e.* in a situation and under conditions the most favourable for infection. And, moreover, the bites of even the most dangerously rabid dog are not by any means invariably rabic, or infective, and, when this is the fact, not in every case equally rabic. There are cases of ordinary "furious" or of exclusively convulsive canine-rabies, where the salivary secretion is absolutely unaffected with "virus." The percentage of bites which never once fail to impart infection is small in the extreme and, as M. Pasteur has frequently pointed out, "altogether exceptional." Nevertheless, it is undoubted that such cases do on very rare occasions present

themselves; and, moreover, there is good reason to show that they always occur at the *outset* of every extensive epidemic of the disease.

Hence, all dog bites, whether rabic or not, have hitherto been systematically treated as infective. All suspicious dogs which have bitten have been as summarily dealt with as if dangerously rabid. The custom, still well-nigh universal, but an extremely senseless one, and which has probably been handed down from the darkest of the so-called Dark Ages, has, hitherto, been to at once destroy any dog which has bitten under suspicious circumstances, not only for fear such animal should be rabid and bite others,—a reasonable enough precaution if an unreasonably excessive one,—but in case it should become rabid and, mysteriously enough, thereby doom the victims it has bitten! Not a few weird fallacies of this order still cling like cobwebs around this senile custom; in this, if in nothing else, disclosing its extremely remote antiquity. The practice of centuries in this matter, and presumably with the object of "erring on the safe side," has been, not so much to give a dog a bad name and then hang him, as to hang the unhappy dog, and then give him a bad name! But has the error been altogether on the safe side? A little consideration will decide.

If a dog which has bitten is summarily to be destroyed on the mere suspicion of rabies, the destruction of the suspected animal cannot, in spite of all the sophistry of the most plausible optimism, prevent the development of the disease in the person so bitten, provided the bite be really a rabic one. If the man has been effectually bitten by a rabid animal, and if the salivary secretion of the latter at the moment of attack has been genuinely rabic;—but the one phenomenon by no means necessarily follows from the other,—such a procedure, however prompt and thorough, cannot prevent the development of hydrophobia, any more than summarily shooting a burglar will extinguish the burning building which he has so effectually kindled. It will not prevent the development of the disease, any more than the escape or the preservation of the dog, if not really rabid, or even when genuinely rabid if its bite be not really rabic, will by any possibility cause rabies. In either case, to precipitately destroy the animal can do no good, but to a certainty will end in the most disastrous regret, for such a procedure destroys once and for ever much valuable information, which otherwise would certainly be disclosed by the preservation (for even a week or ten days) of the animal.

Thus, if the suspicion be groundless, the person bitten, after the untimely destruction of the animal, can never be certain whether or not at the moment of attack it was really rabid. Consequently, for many months thereafter, if not years, the man, however strong-minded, will become a victim, and possibly a very needless one, to the most harassing dread and delusion; which can only become more fixed and acute as time passes, and which, there is some reason to believe, have not unfrequently ended, in neurotic subjects, in hopeless alcoholism or in genuine insanity itself. On the other hand, in the event of the victim to the dog-bite proving to be actually infected, the prostrating dread arising from the uncertainty of this fact will only have the effect of intensifying a case of, it may be, a less and even the least severe form of hydrophobia,—a convulsive hydrophobia,—and easily amenable to the Pasteurian "prevention," into one of the most deadly paralytic forms, and which probably no course of inoculations could "prevent." Of all conditions favourable to the development of the rabific microbe, such unceasing and prostrating anguish is, there is good reason to show, the most "predisposing." Now if, instead of ruthlessly destroying the suspected dog, it be chained up and kept under competent observation for a few days, the nightmare dread will soon be cleared. If at the moment of attack the animal has been really rabid, on confinement it will at once reveal this fact; and all the more readily and effectually for the confinement and the strictest suspicion and scrutiny. But, although unquestionably rabid, it will not follow that the bite of such a dog will be infective; for it by no means follows that the salivary secretion of the ordinary "furious" canine-rabies is invariably charged with the "virus" of the disease. On the preservation of the animal, however, this important fact, or the essentially convulsive or "furious" character of the malady, could at once be disclosed. But, again, under competent observation it might and would be, sooner or later, found that, whilst not rabid at the moment of inflicting the bites, the animal, nevertheless, was unquestionably in the incubation-stage of the disease. This likewise is a revelation of the utmost value. If the animal do not exhibit rabies before a week or ten days after having inflicted the bite, it may be taken for granted that there has been no infection in the case, even although the canine-rabies, when developed, should prove to be of the most infective and deadly character, and although the wounds inflicted should be of the most extensive and dangerous kind. There is no evidence whatever to prove

that a dog, or any other animal, merely in the incubation-period of the disease,—not at least until the final stages of incubation,—is capable of imparting rabies with its bite; there being good ground to show that the salivary secretion is not in any way or to the slightest extent charged with "virus" or the rabies-germ during any such stage of the malady. What possible benefit, then, can accrue from the prompt destruction of a rabid dog merely in the incubation-stage of the disease? How, in such circumstances, can the preservation of a suspected dog, however "furious," fail to prove of inexpressible value to the victim of its bite, since, under competent examination, it has been so clearly established by the delay that the wounds inflicted could not by any possibility have been rabic, having been inflicted at a stage of the malady when infection was impossible? Lastly, if it should turn out on examination that the suspected animal is not rabid at all, merely "aggressive" and savage, and that the bite of the animal is, therefore, not in any sense rabic, as in the vast majority of dog-bites must necessarily be the case,—for canine-rabies, after all, is fortunately a very rare disease,—then, by the disclosure of such a fact, the patient's peace of mind may be at once restored. By the heedless destruction of the animal all such light is effectually extinguished. If to summarily destroy a suspected animal be "an error *in the right direction*" and "*on the safe side*," where is the particular safety? where is the wisdom of such a proceeding? It is but the blind act of panic, which is always as fatuous as it is fatal. To destroy a suspected creature, merely on suspicion and in a panic, is to destroy, not the suspicion nor the panic, but the only source of information on the subject, and the only guide to action. Is this, then, desirable?

From such facts, if there were no other, it is obvious that the infective rate of canine-rabies itself, or that of any other animal equally capable of attenuating the disease, is far from constant or invariable. All animals are not by any means alike when the rabies-germ is transmitted serially through them. The vast majority of animals *intensify* the disease on transmission. As we shall see more fully as we proceed, the entire herbivorous order, great and small, from the horse to the guinea-pig, intensify rabies, when the disease is passed serially through any given group. On the other hand, there are animals which progressively *attenuate* or lessen the disease as it is passed through them. The monkey is an excellent example of this division of the animal kingdom. But the attenuating division is very much smaller than the intensifying; and it was a

considerable time before M. Pasteur actually discovered that the monkey was capable of progressively attenuating the rabies-virus of even the most potent forms of the disease. The animal kingdom, then, may conveniently be divided into *attenuators* and *intensifiers*; or the class of animal, such as the herbivorous, which intensifies rabies on its being transmitted serially, and the class of animal, such as the monkey or the dog, which attenuates the disease on its being transmitted through a group from one to the other. In studying the disease, these two important orders must always be borne in mind; for they are absolute contrasts.

The condition of the salivary secretion with respect to the possession of the infective material of the malady is no more uniform than any other feature of the disease, or even than any other feature of the salivary secretion itself. A dog may be most violently "furious," biting incessantly, without its bite being necessarily rabic; just as, on the contrary,—which, however, is often ignored,—a dog may be profoundly and paralytically rabid without being at all frantic or "furious," and without any tendency to bite, and yet the salivary secretion of the animal be uniformly saturated with "virus." The salivary secretion of every animal capable of attenuating rabies, on transmission, is not precisely alike, in any group of cases, either in amount, in consistency, in liquidity, or in infectiveness, any more than all cases are precisely alike in the length of the incubation-period, in the duration and sequence of the symptoms, and in the extent and character of the lesions; well-nigh every case, as M. Pasteur from the first pointed out, having its own set of symptoms, its own train of lesions, its own incubation-period, and its own infective rate, or a character of the salivary secretion, with respect to infectiveness, peculiar to itself. Thus, in the great majority of the exclusively "furious" or convulsive, as opposed to the convulso-paralytic, or of the pronounced paralytic and "mortal" forms, the salivary secretion is scanty in amount; and this scanty secretion is viscid, clammy and frothy in character. In profound paralytic rabies, on the contrary, the salivary secretion is copious in amount; and this copious secretion is, moreover, thin and liquid in the extreme and constantly dripping from the angles of the mouth. This feature has been noted, directly or indirectly, by every modern authority. M. Galtier noted it very emphatically from the outset in his admirable description of the disease in the rabbit. "There is," he says, "*always an abundant flow of saliva*[1]."

[1] *Bull. Académ. de Méd.*, January 25, 1881.

And precisely the same difference is noticeable in the churned frothiness of convulsions, epilepsy and acute mania, as contrasted with the thin, copious dribbling of idiotcy or of apoplectic paralysis. Now, if it so happened that the scanty and frothy salivary secretion of the ordinary "furious" rabies,—and this, it must be emphasised, is the most prevalent form of the disease in the dog,—*alone* contained the infective matter; were the salivary secretion of such cases not merely variously charged, but invariably saturated with the virus-germ, such cases would still be completely amenable to local surgical treatment. It would be but like wiping out the acrid insect-froth and its eggs from the interior of a flower. This, however, is far from the fact. The "furious" cases, prevalent as they are in every outbreak, are the least likely to impart infection by a bite, in spite of the fact that they are by far the most aggressive; because the viscid, churned salivary secretion, characteristic of such cases, would not, irrespective of local treatment, necessarily be absorbed, being the least absorbent of any form of secretion; and because, on the other hand, if copious in amount and highly absorbent, which is contrary to the fact, the secretion contains, there is good evidence to show, and in proportion to the amount of mere "fury" or convulsiveness, little or no virus. With respect to the essentially paralytic or "dumb" forms, on the other hand, we find that the salivary secretion is practically unlimited; and, moreover, that, far from being viscid, it is thin, liquid and absorbent in the highest degree, like the secretion of any other paralysis, and in proportion to the extent of the paralysis. So much so that, were the secretion but slightly and occasionally charged with the "virus," which, unfortunately, is diametrically opposed to the fact, it is inconceivable that any local surgical treatment, however prompt and thorough, could have the slightest effect in "preventing" its absorption in the wounded tissues. No amount of excision and cauterising, however immediate, will prevent the absorption of a hypodermic syringeful of a solution of morphia or strychnine, much less of tuberculin or of serpent-venom, or of prussic acid; yet any of these is not more easily absorbed than the thin, liquid rabic secretion of a profoundly paralytic or "dumb" canine-rabies. But these cases, where the saliva is so abundant and so easily absorbed, are likewise the very cases in which the secretion is more or less saturated with "virus," the amount of saturation being also proportioned to the amount of paralysis in the case. They are forms of the disease where the ancient surgical treatment is most wanted but of least avail;

"the cauterising," etc., when heroically done, having the effect, it may be, of sealing up the rabific microbes in the tissues rather than of destroying them. The amount of "virus" in the saliva of canine-rabies, then, far from being equal, uniform, and constant, would appear to range from zero or absolute nil up to saturation-point.

Nor is the salivary gland the only secreting organ in which the rabies-germ is to be found. Nevertheless, from the remotest ages, the "virus" has been exclusively associated with the salivary secretion; and even from the earliest of the experimental investigations it has always been, first and foremost, purposely searched for, and its presence proved, in the saliva or salivary apparatus of the infected dog. Thus, Paul Bert, Nocard of Alfort, Duboué, Galtier of Lyons, and the entire circle of French investigators,—for from the first France took the lead in the experimental investigations,—had, as their first discoveries, ascertained that the substance of the salivary and parotid glands, in severe cases, and according to their severity and the predominance of the paralytic element, is invariably rabic. In separating and differentiating the virulent and non-virulent elements of even this salivary structure itself, M. Nocard went a step further than other investigators. He ingeniously dialysed the saliva, with the result, which will be referred to again, that, whilst the solid elements of the secretion were found to be virulent, the liquid element, passed through the dialyser, when similarly injected into healthy animals, on every occasion failed to rabidise. From such experiments the impression was, if anything, but deepened that the salivary tissue was the prime seat of the rabies-germ, and the exclusive site of the elaboration of its virus.

"The saliva," as M. Pasteur justly stated, on publishing the first results of his own investigation, "was the only part where the presence of the virus had been detected with certainty[1]."

So deeply rooted was this idea in the best prevalent conceptions of the malady, that M. Pasteur himself began his great research with the salivary substance of a child who had died of hydrophobia. But hydrophobia is *par excellence* the convulsive or "furious" rabies of the dog. Is it not obvious, therefore, from this one historic "instance," that the salivary secretion of the most ordinary rabies, not less than that of the very rare "dumb" or paralytic form, is invariably rabic? It does not follow. This, as it happened, was no ordinary "instance"; and it was fortunate for humanity that it was not.

[1] *Comptes Rendus*, Dec. 11, 1882.

From the fact of being that of a young child, and more especially, as we shall see hereafter, a delicate young girl, this case was, there is good reason to show, in all likelihood of the severest form of hydrophobia to be met with, probably a case of paralytic hydrophobia. If this were so, the child's salivary substance would undoubtedly be exceptionally rabic, and, therefore, exceptionally favourable for experimentation. Be this as it may, certain it is that, if M. Pasteur began his research with the salivary substance, he by no means kept to it. He very far from adopted it even from the most pronounced paralytic forms of rabies, although the most infective, as the source whence to obtain the "virus" in its purest, most unadulterated and most "unmodified" condition, or in point of fact as a source from which to obtain it at all. It would appear that the saliva of the most profound paralytic forms of rabies to be met with, however saturated with "virus," is frequently impure and adulterated in the extreme, and not at all to be relied on for experimental purposes.

"In the saliva of rabid animals the virus is found associated with various micro-organisms; and the inoculations of this can give rise to death in one of three modes:

(*a*) By the new microbe, which we have described under the name of 'the microbe of saliva.'

(*b*) By the excessive development of pus.

(*c*) By rabies[1]."

But if this holds good of the saliva of the profoundest paralytic canine-rabies, or rabbit-rabies itself, how much more is it true of the rabic saliva, when such presents itself, of an ordinary "furious" or *convulsive* rabies? If this inconstancy and uncertainty of infectiveness should exist in the case of an admittedly most virulent saliva arising, probably, from the "association" of distinctly antagonistic elements, what shall be said of the saliva of the rabid dog, *furiously* rabid, which is not virulent, and which contains no infective material at all? Such unquestionably exists, and not only on rare occasions, but in a very considerable percentage of cases. Thus, in direct opposition to the Lyons school, which had all but formally stated it as a fundamental fact of rabies, that the "virus" exists primarily and invariably in the salivary secretion, M. Pasteur deliberately asserted at the outset of his own research that "The saliva inoculated by a bite, or by direct injection, into the areolar tissue, *does not constantly give rise to rabies*[2]."

[1] *Comptes Rendus*, Dec. 11, 1882. [2] *Ibidem.*

The saliva of the mad dog, then, is not only, *not* invariably, infective, but, as it so happens, even on the rare occasions when it is, the rabic material is by no means confined to the salivary glandular substance. According to the severity of the case, and to the predominance of the paralytic over a merely convulsive element, apparently well-nigh every secreting organ is capable of more or less eliminating the "virus." At an early stage of the experimental investigation, Paul Bert ascertained that the bronchial mucus "was to a high degree virulent." And Galtier was able to detect the "virus" "not only in the lingual glands, but in the bucco-pharyngeal mucous membrane." It has also been detected in the mucous membrane of the stomach, and in the substance of the liver itself. It has been copiously found by Galtier, Bouchard, and others in the lymphatic glands and fluids, and on very rare occasions by M. Pasteur himself even in the blood stream. Above all, it has been discovered by M. Pasteur in the richest abundance in the nervous substance of the entire cerebro-spinal substance from its centre to its remotest periphery. Still more recently, Burdoni-Uffreduzzi, of Turin, has made an extensive series of experiments on dogs and various animals, solely "to test the different degrees of virulence of the various organs." And he has found, not only that "various parts of the brain of a rabid animal show different degrees of virulence," as demonstrated so conclusively by M. Pasteur himself, but that "the pancreatic gland is nearly as virulent as the brain"; and, moreover, that "the liver and spleen, although seemingly acting much less strongly as media of the disease, are nevertheless, at times," or in the most severe paralytic cases, "highly charged and even infiltrated with the virus[1]." Thus, it is clear that there is probably not a secreting gland, any more than a mucous membrane, which, according to the paralysing virulence of the case, is not more or less charged with "virus," the amount of paralysis being a very fair index of the amount of the virus and rabific microbe in the glandular or secreting system. The salivary gland, if more constantly and intensely virulent than any other secreting organ, is by no means the only organ which eliminates "virus." The existence of the infective material in this structure is neither constant, nor, when present, is its presence in the secretion by any means unique.

The bite of a mad dog, therefore, although the animal should die of the rabies, furiously rabid, is not necessarily, and very far from

[1] *Nature*, Oct. 27, 1887, The Sixth International Congress of Hygiene in Vienna.

invariably, infective. The reverse of this constancy is now a well-established fact. How, under such circumstances, can the salivary gland be viewed as the specific seat of the rabies-germ, and where it alone elaborates its "virus"?

But, it may be said, and with justice, that it does not follow, because the bite of a mad dog fails to rabidise in some instances, that it is not necessarily a rabic one in any instance, or, in other words, that there is no "virus" at all in this salivary secretion. The bite may be a genuinely rabic one, and yet fail to infect. As it so happens, there are in every living animal natural *preventative* conditions of a very positive and constant character, which render the fact of infection far from certain in the most desperate and formidable attacks. These conditions may be described as of an extrinsic and an intrinsic character. The *extrinsic* preventative conditions are, so to speak, accidental to, or at least independent of, the animal or its condition, and are common to all animals. They are comprised in such natural acquisitions as fur, hair, horn, hoof, wool, clothing, etc., which at times, as in the sheep, effectually clear and clean a venomous bite of its "virus." Although more or less common to all animals, such extrinsic defence is, however, preeminently characteristic of the class of animals capable of intensifying rabies on transmission, such as the guinea-pig, hare, and rabbit; being in this entire order, the main, and in some of the class, such as the rabbit, probably the exclusive preventative conditions. The strictly *intrinsic* preventative conditions, on the contrary, are of the most vital importance to the animal, and are in reality but an expression of its vigorous vitality; this all-important refractory power, being, as we shall see, essentially physiological. This intrinsic refractory capacity is in reality pre-eminently, if not exclusively, characteristic of the class of animals capable of attenuating the disease on transmission, such as man, the monkey, and the dog; and in respect of the entire intensifying division of the animal kingdom, is reduced to a minimum, and in the most potent intensifiers is even conspicuous for its absence. Now, in nature these preventative conditions in one form or another, and often in combination, are constantly at work to ward off infection. In an attenuating animal, such as the dog, both conditions are of the most pronounced character. For refractoriness to rabies, man is certainly not less specially provided than the dog, and, probably, for the same reason. John Hunter has even noted that "dogs are *more* susceptible of the infection than the human species."